Mathematical approaches to modeling development and reprogramming.

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Public Summary:
Induced pluripotent stem cells (iPSCs) are created by the reprogramming of somatic cells via overexpression of certain transcription factors, such as the originally described Yamanaka factors: Oct4, Sox2, Klf4, and c-Myc (OSKM). Here we discuss recent advancements in iPSC reprogramming and introduce mathematical approaches to help map the landscape between cell states during reprogramming. Our modelization indicates that OSKM expression diminishes and/or changes potential barriers between cell states and that epigenetic remodeling facilitate these transitions. From a practical perspective, the modeling approaches outlined here allow us to predict the time necessary to create a given number of iPSC colonies or the number of reprogrammed cells generated in a given time. Additional investigations will help to further refine modeling strategies, rendering them applicable toward the study of the development and stability of cancer cells or even other reprogramming processes such as lineage conversion. Ultimately, a quantitative understanding of cell state transitions might facilitate the establishment of regenerative medicine strategies and enhance the translation of reprogramming technologies into the clinic.

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